PRIVATE AND CONFIDENTIAL

RESEARCH DEPARTMENT

The Südfunk 'Diamond' a.m./f.m. portable receiver

Model K91095

REPORT No. G-087

1963/47

THE BRITISH BROADCASTING CORPORATION
ENGINEERING DIVISION

RESEARCH DEPARTMENT

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SUMMARY

This report gives the results of tests on the Südfunk 'Diamond' receiver on the v.h.f. f.m. range. The performance of the receiver is satisfactory in most respects although with signal inputs of 100 μV or less the a.m. suppression falls rather sharply.

1. DESCRIPTION

1.1. General Description

The Südfunk 'Diamond', Model K91095, transistor portable receiver, a photograph of which is shown in Fig. 1, is of West German manufacture. It is housed in a light wooden cabinet covered in black leatherette plastic. A built-in ferrite dipole is provided for the medium- and long-wave ranges and a telescopic rod-aerial for v.h.f. f.m. A 4 in (10 cm) diameter internal loudspeaker is used.

At the time when the receiver was purchased in May 1962, its retail price in Britain was £33. 12. 0d including tax.

Dimensions

10¾ in wide × 7 in high × 3½ in deep (27 cm × 18 cm × 9 cm)

Weight

4·5 lbs (2·0 kg) including batteries

Controls Left to right, top of case:

(a) Volume control

(b) Push-button wave-range switch

(c) On/off and two-position tone control switch

Front of case

(d) Tuning control

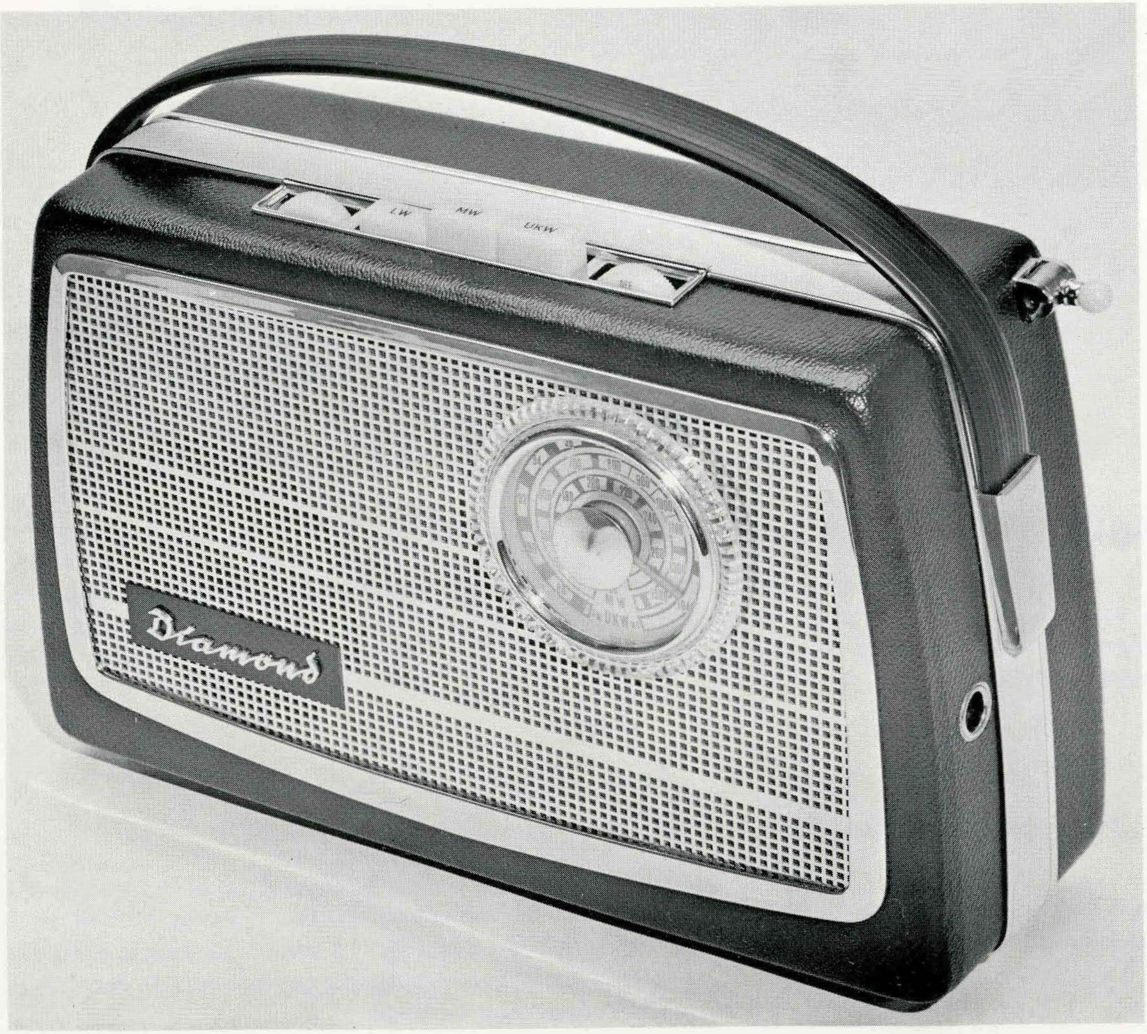


Fig. 1 - Photograph of receiver

Wavebands

Long: 1100 - 1870 m
Medium: 200 - 570 m
V.H.F.: 87 - 104 Mc/s

Battery Supplies

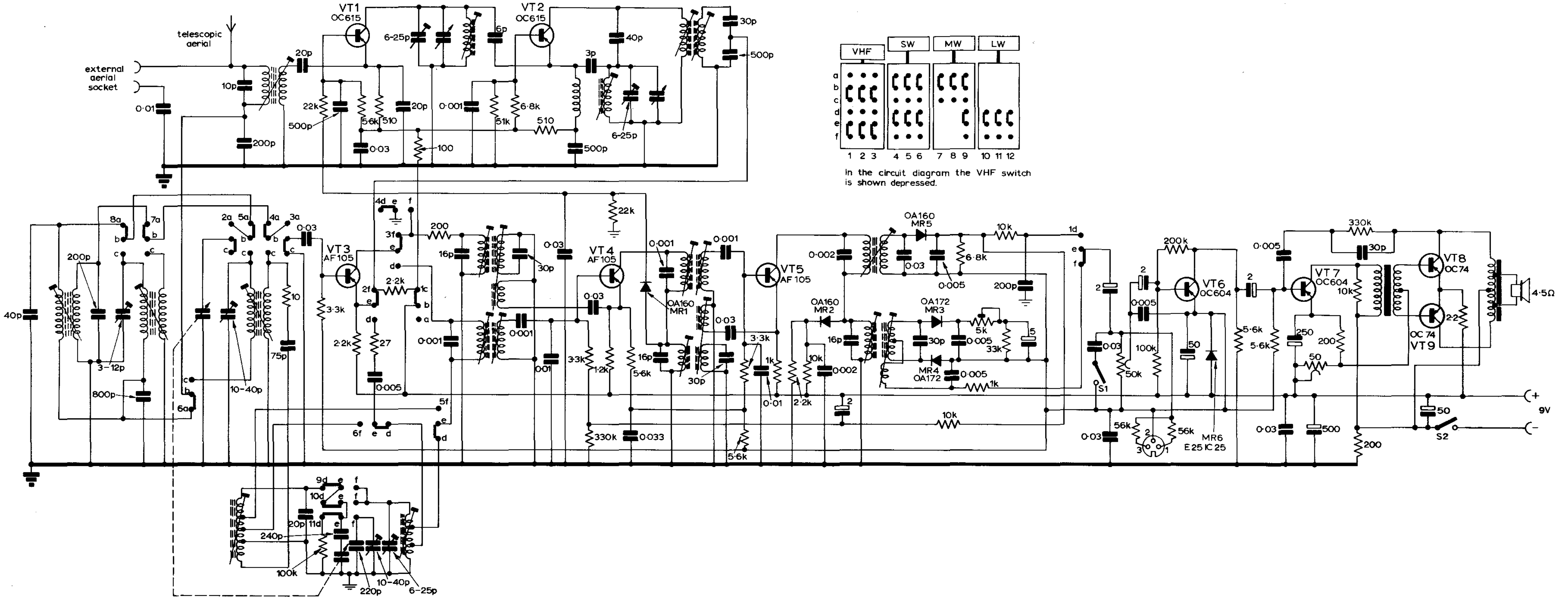
Two 4·5V batteries, series connected (Ever Ready type 1289 or equivalent)

External Connexions

External aerial socket

1.2. Description of Circuit

The circuit is essentially the same as shown in Fig. 2 except that the S.W. band was not included in the receiver tested. Nine transistors and six semiconductor diodes are employed, the types and functions being summarized in Table 1.



In the circuit diagram the VHF switch is shown depressed.

Fig. 2 - Circuit diagram

TABLE 1

TRANSISTORS AND DIODES	FUNCTION	
	A.M. ranges	V.H.F. range
VT1 OC615	not used	r.f. amplifier
VT2 OC615	not used	oscillator-mixer
VT3 AF105	oscillator-mixer	i.f. amplifier
VT4 AF105	i.f. amplifier	
VT5 AF105		
MR1 OA160	not used	a.g.c. rectifier
MR2 OA160	not used	diode limiter
MR3 OA172	not used	ratio detector
MR4 OA172	not used	
MR5 OA160	a.m. detector	not used
MR6 E251C25	bias stabilizer for VT6	
VT6 OC604	first a.f. amplifier	
VT7 OC604	a.f. driver stage	
VT8 OC74	push-pull a.f. output stage	
VT9 OC74		

The a.m./f.m. switching arrangements are basically similar to those employed in a valve receiver. Transistors VT1 and VT2 are inoperative on the a.m. ranges, and transistors VT3 - 5 are used in a superheterodyne circuit with an intermediate frequency of 465 kc/s. The a.g.c. voltage, in a.m. operation, is derived from the signal rectifier MR5 and applied to the first i.f. amplifier VT4.

On the v.h.f. range, VT1 functions as a common-base r.f. amplifier and VT2 as a self-oscillating mixer. The oscillator frequency is higher than the signal frequency; this is contrary to the standard British practice. VT3 - 5 form a three-stage i.f. amplifier with a centre frequency of 10·7 Mc/s. MR1 is the v.h.f. a.g.c. rectifier and the control voltage is applied to the r.f. amplifier VT1. MR2 is a diode limiter. The i.f. amplifier transistors operate in the common-emitter configuration on the a.m. ranges but with common base on the v.h.f. range.

Transistors VT6 - 9 are used in the audio-frequency amplifier, with negative feedback applied from the primary of the output transformer to the input of the driver stage. The loudspeaker impedance is 4·5 ohms.

2. TEST RESULTS

The receiver was tested in accordance with the specification contained in Research Department Technical Memorandum G-1003 (Issue 2), with some additional tests.

It should be noted that all ratios of signal-to-noise, hum or interference quoted were measured with a mean-square meter preceded by an aural sensitivity weighting network based on the CCIR (1934) curve for broadcast relay circuits. Unless otherwise stated, all signal levels refer to the open-circuit voltage from a 75-ohm source. In all tests apart from 2.2.3., the tone control was set for maximum top response.

2.1. Sensitivity

The sensitivity of the receiver is defined as the minimum amplitude of signal input which satisfies simultaneously the following tests: 2.1.1., 2.1.2 and 2.1.3.

The measured value was 25 μV.

2.1.1. Absolute Sensitivity

This is the minimum input signal amplitude, deviated ± 35 kc/s* at a frequency of 2000 c/s, which will produce an output of 50 mW with the receiver gain control at maximum.

The measured value was 4 μV.

2.1.2. Maximum Deviation Sensitivity for 10% Harmonic Distortion

This is the minimum input signal amplitude, deviated ± 75 kc/s at a frequency of 400 c/s, which produces a total harmonic distortion of 10%

The measured value was 6·3 μV.

2.1.3. Sensitivity for Standard Signal-to-Noise Ratio

This is the minimum input signal amplitude, deviated ± 35 kc/s at a frequency of 2000 c/s, which will produce an output signal-to-noise ratio of 40 dB.

The measured value was 25 μV.

2.2. Fidelity

2.2.1. Variation of Harmonic Distortion with Deviation

Fig. 3 shows the total harmonic distortion as a function of deviation with the receiver gain control set to give 50 mW output with ± 30 kc/s deviation at 400 c/s. The input signal level was 10 mV.

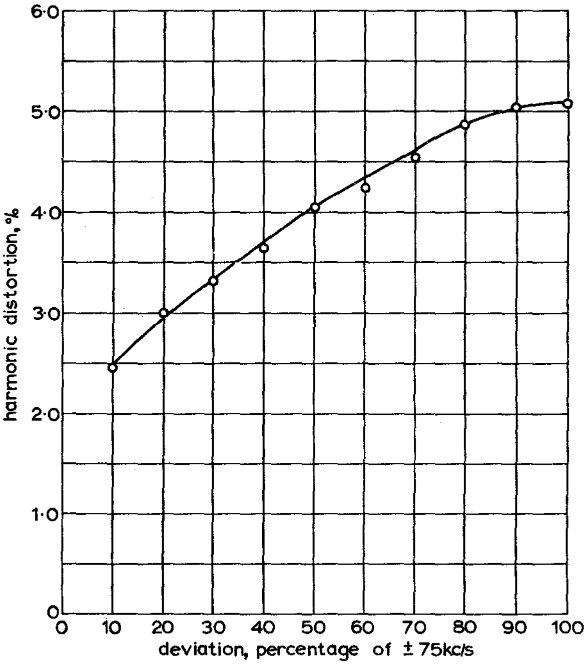


Fig. 3 - Variation of harmonic distortion with deviation

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*This is equivalent to ± 30 kc/s (i.e. 40% of ± 75 kc/s) at a low audio frequency if allowance for standard pre-emphasis is made.

2.2.2. Maximum Output Power for 10% Total Harmonic Distortion

The measured value was 740 mW.

2.2.3. Modulation-Frequency Characteristic

This is shown in Fig. 4; the curve is corrected for a 50 μs pre-emphasis time constant.

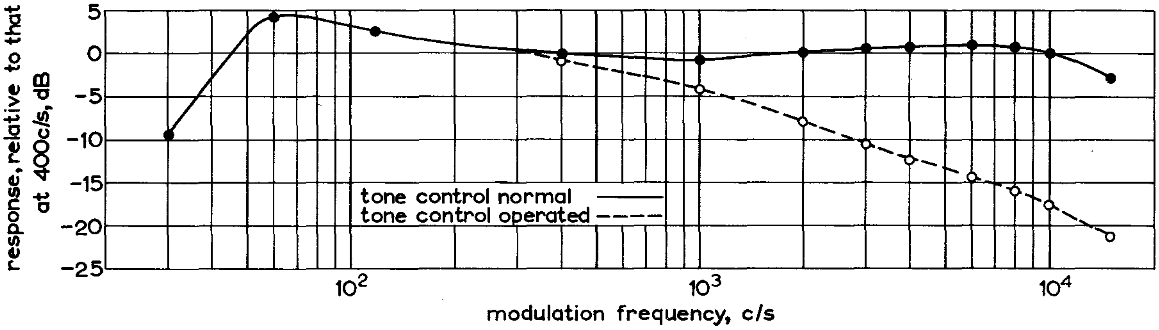

Fig. 4 - Modulation-frequency response

2.3. Selectivity

The suppression ratio for an interfering signal is measured objectively as the ratio of unwanted-to-wanted signal amplitudes giving an output signal-to-interference ratio of 40 dB when the interfering signal is frequency modulated at 2000 c/s with a deviation of ± 35 kc/s.

The results for adjacent-, second- and third-channel interference (i.e. with 200, 400 and 600 kc/s frequency separations respectively) are given in Table 2, together with the measured ratio for the image channel.

The wanted carrier level in each case was 1 mV.

TABLE 2

FREQUENCY OF UNWANTED CARRIER RELATIVE TO WANTED CARRIER	-600 kc/s	-400 kc/s	-200 kc/s	+200 kc/s	+400 kc/s	+600 kc/s	+21·4 Mc/s
Ratio of unwanted- to wanted carrier levels (dB)	+17	+9	-8	-14	+5	+17·5	+20·5

2.4. Local-Oscillator Performance

2.4.1. Local-Oscillator Drift

The frequency variation of the local oscillator is shown in Fig. 5. Since the local-oscillator frequency is sensitive to battery voltage the receiver, for this test, was connected to a 9V stabilized supply.

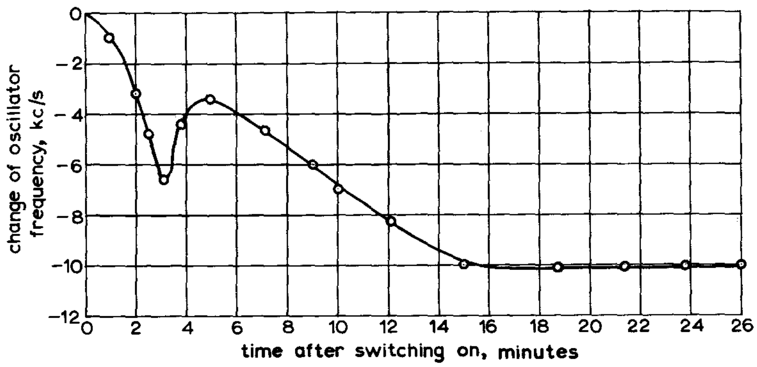

Fig. 5 - Local-oscillator frequency drift

2.4.2. Dependence of Local-Oscillator Frequency on Battery Voltage

This is shown in Fig. 6.

2.4.3. Local-Oscillator Radiation

In this test the voltage across the input terminals of the receiver due to the local oscillator was measured, the input terminals being terminated in 75 ohms.

The measured voltage was 4·5 mV.

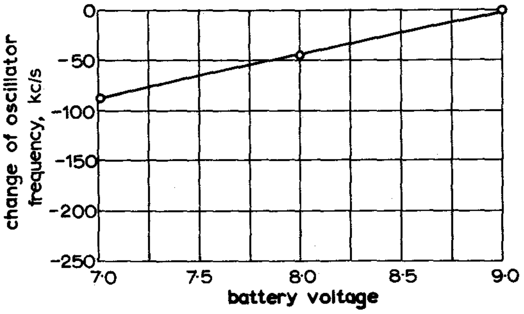

Fig. 6.- Dependence of local-oscillator frequency on battery voltage

2.5. Co-Channel Suppression Ratio

This was measured by the technique described in Section 2.3., but with the interfering signal frequency differing from the wanted signal by less than 1 kc/s.

The measured value was -16 dB.

2.6. Suppression of Amplitude Modulation

The a.m. suppression ratio is the ratio between the output due to a carrier which is frequency modulated ± 35 kc/s at 2000 c/s and that due to a carrier which is simultaneously amplitude modulated to a depth of 40% at 2000 c/s and frequency modulated ± 30 kc/s at 100 c/s, the 100 c/s output being rejected by a high-pass filter. The results for various input signal levels are shown in Table 3.

TABLE 3

INPUT SIGNAL LEVEL	A.M. SUPPRESSION RATIO (dB)
10 μV	9
30 μV	18
100 μV	19
300 μV	28
1 mV	36
10 mV	35

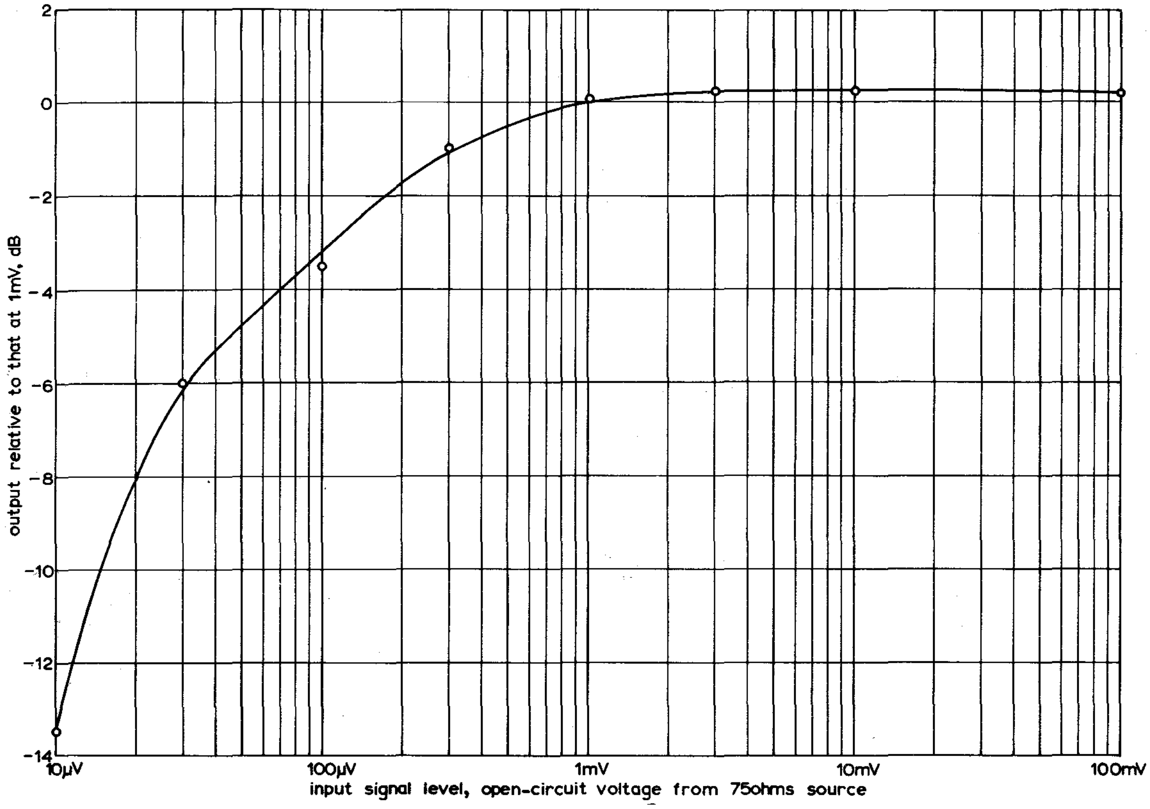

Fig. 7 - Variation of a.f. output with signal level

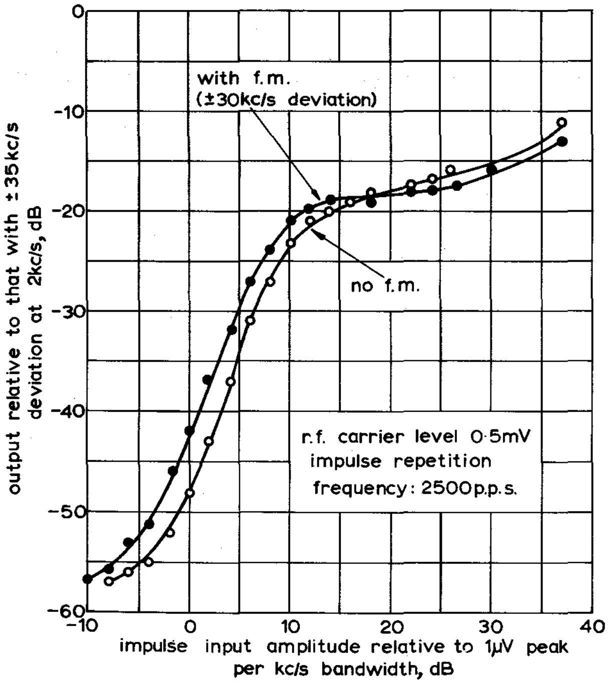

Fig. 8 - Input/output characteristic for impulsive interference

2.7. Dependence of Output on Signal level

This is shown in Fig. 7.

2.8. Impulsive Interference Performance

Fig. 8 shows the output due to impulsive interference, relative to that due to ± 35 kc/s deviation at 2000 c/s, for various input impulse amplitudes.

The measurements were made in the presence of an input carrier of 500 μV, firstly unmodulated and secondly frequency modulated with ± 30 kc/s deviation at 12 kc/s.

2.9. Variation of Current Consumption with Output Power

This is shown in Fig. 9; the signal input level was 1 mV.

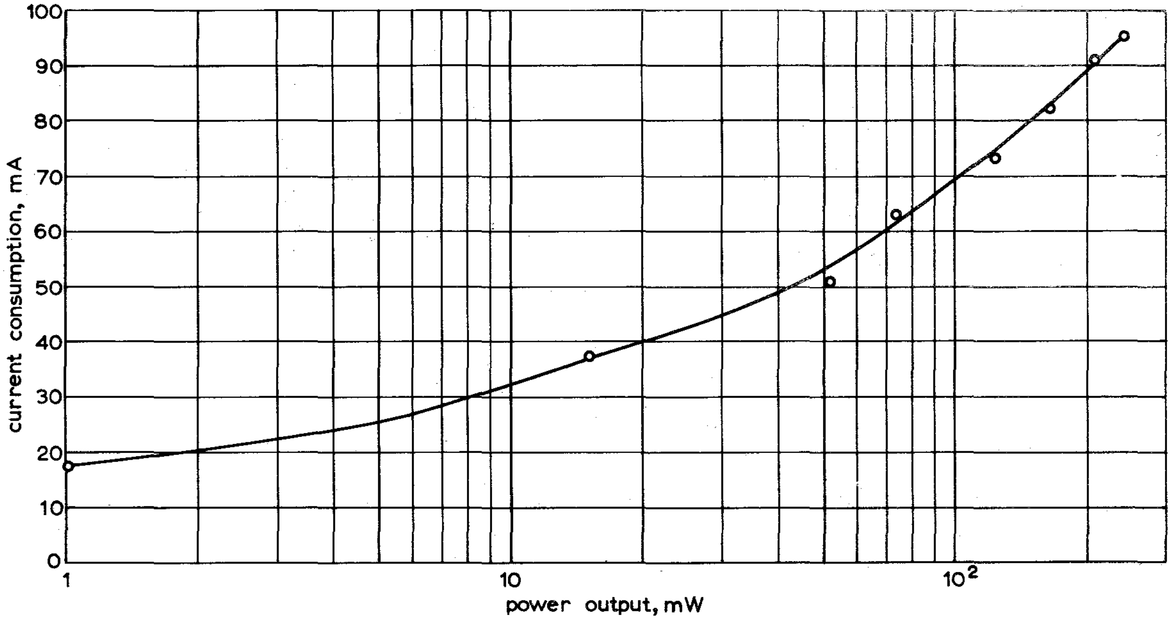

Fig. 9 - Variation of current consumption with output power

3. CONCLUSIONS

The a.m. suppression ratio is adequate at the higher signal levels but falls off with inputs below 300 μV. Susceptibility to interference from other transmissions is also rather higher than usual, particularly with frequency offsets of 400 kc/s and 600 kc/s.

In other respects the performance is quite good and the output volume obtainable is greater than one expects from a receiver of this type.

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